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SPECIFICATION

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TITLE: ~~SIGNAL AMPLIFYING CIRCUIT IN CCD CAMERA~~

5 BACKGROUND OF THE INVENTION

6 1. Field of the Invention

7 This invention relates to a signal amplifying circuit in a
8 CCD (Charge Couple Device) camera using an area image sensor for
9 use in a device such as a monitoring video camera.

10 2. Background Information

11 Heretofore, as shown in Fig. 5, in a conventional CCD
12 camera, a light signal passed through lens a is transduced into
13 signal S₁, by CCD sensor b. The signal S₁ is a sampling held in
14 CDS c as signal S₁, the signal S₁ is processed in processing
15 circuit d and output from signal input part 1 as signal S₂ as
16 shown in Fig. 6.

17 This invention relates to processing circuit d which is
18 explained in more detail. As shown in Fig. 5, OSC (oscillator)
19 2 generates a synchronizing signal, timing generator 3 drives a
20 CCD, V driver 4 is an iris signal S₄ output from processing
21 circuit d for an automatic iris.

22 To obtain composite video signal S₁, processing circuit d
23 is constructed as shown in Fig. 7. Input signal S₁ is amplified
24 to a predetermined level V₁ in AGC amplifier e and transduced
25 into constant level signal S₃. On the other hand, signal S₄
amplified in fixed amplifier f is output as a control signal of

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1 a lens having an automatic iris or control signal for inputting
2 a light limiting circuit.

3 Operation of above device is as follows:

4 Signal S₃, AGC, amplified in AGC amplifier e is passed by
5 low pass filter g, to remove a useless wide frequency component,
6 passed through gamma correction circuit h, white clip circuit i,
7 composite sync mixer j, driver k (matching to 75 ohm line) and
8 output as a video output signal S₂ shown in Fig. 6. In the
9 composite video output signal S₂, the S/N (signal to noise)
10 ratio is set to more than 40dB(1%). This invention concerns the
11 S/N ratio.

12 Problems to be solved by this invention.

13 If an object is illuminated by a sufficient light source of
14 more than 0.02 lux, the S/N ratio is kept more than 40dB(1%) and
15 no problems occur, but in low illumination such as night,
16 photographing is impossible. However, in night photographing,
17 it is desired to broaden the range of illuminating until 0.02
18 lux under a wrong S/N ratio.

19 BRIEF DESCRIPTION OF THE INVENTION

20 This invention intends to eliminate said drawbacks, and an
21 object of this invention is to provide a signal amplifying
22 circuit in a CCD (Charge Couple Device) camera in which under a
23 sufficient object illuminating conditions (normally more than
24 0.02 lux) photographing normal circuit construction (Figs. 5 and
25 7), while under a low object illuminating condition,

1 photographing while ignoring the S/N ratio, by inserting
2 auxiliary amplifying circuit m or raising the amplification
3 factor of AGC amplifier e .

4 Namely, in this invention when photographing at normal
5 object illumination, the photograph is at a high S/N ratio and
6 high grade, but when photographing at a low object illumination,
7 the photograph is at high noise and ignoring the utility 20db
8 S/N ratio (noise component 10%).

9 The detection means of said low object illumination is an
10 output level of fixed amplifier f or lowering of the video
11 output level (Fig. 2).

12 The above and other objects, advantages and novel features
13 of this invention will be more fully understood from the
14 following detailed description and the accompanying drawings, in
15 which like reference numbers indicate like or similar parts
16 throughout wherein:

17 BRIEF DESCRIPTION OF THE DRAWINGS

18 Fig. 1 is a block diagram of a first embodiment of this
19 invention.

20 Fig. 2 (A) shows the relation of object Lux (abscissa) and
21 video output voltage (ordinate) of a prior device (dotted line)
22 and this invention. (B) shows the relation of object Lux
23 (abscissa) and S/N ratio (ordinate) of this invention. (C)
24 shows the relation of object Lux (abscissa) and gain of
25 auxiliary amplifying circuit m (ordinate) of this invention.

1 Fig. 3 is a block diagram of a second embodiment of this
2 invention.

3 Fig. 4 is a block diagram of a third embodiment of this
4 invention.

5 Fig. 5 is a block diagram of a conventional CCD camera.

6 Fig. 6 is a graph of video output signal S_2 .

7 Fig. 7 is a block diagram of the processing circuit d in a
8 conventional CCD camera.

9 DETAILED DESCRIPTION OF THE INVENTION

10 According to claim 1 of this invention, signal processing
11 circuit d of a video camera using a CCD, area sensor etc. is
12 increased in an auxiliary amplifying circuit m, the
13 amplification degree of the auxiliary amplifying circuit m being
14 raised according to necessity so as to maintain the video output
15 voltage at a predetermined voltage and vary the amplification
16 degree of the processing circuit d so that the range of
17 photographing is broadened.

18 ~~According to claim 2 of this invention, signal processing~~
19 ~~circuit d of a video camera using a CCD, area sensor etc.~~
20 ~~provides an automatic gain control auxiliary amplifying circuit~~
21 ~~m₁~~ ~~of high S/N ratio, low amplification degree and automatic~~
22 ~~gain control auxiliary amplifying circuit m₂~~ ~~of low S/N ratio,~~
23 ~~high amplification degree, according to necessity, it is~~
24 ~~possible to selectively use automatic gain control auxiliary~~
25 ~~amplifying circuit m₁~~ ~~of high S/N ratio or automatic gain~~

1 *Automatic* control auxiliary amplifying circuit m_2 of low S/N ratio.

2 According to claim 3 of this invention, signal processing
3 circuit d of a video camera using a CCD, area sensor etc. the
4 function of said two automatic gain control auxiliary amplifying
5 circuits m_1 and m_2 in claim 2 are included in one AGC amplifying
6 circuit em which functions are switched by outer switching.

7 According to claim 4 of this invention, to detect the
8 change of object illumination, the output voltage or the signal
9 level in signal amplifying process is detected.

10 Embodiments.

11 First Embodiment.

12 Fig. 1 illustrates the first embodiment of this invention.

13 As shown in Fig. 1, in this invention, auxiliary amplifying
14 circuit m is newly inserted between low pass filter g and gamma
15 correction circuit h in a conventional circuit shown in Figs. 5
16 and 7 which raises the amplification degree by detecting the
17 variation in the video output voltage (Fig. 2). The
18 amplification degree of the auxiliary amplifying circuit m
19 changes from 0 dB to 20 dB.

20 Operation of above device is as follows:

21 In normal photography, the amplification degree is 0 dB.

22 AGC level detector r monitors video output signal S_2 and if
23 the image signal is lower than 0.72v, the output of level
24 detector r changes and the amplification degree of the auxiliary
25 amplifying circuit m increases.

1 By said feedback operation, the video output voltage is
2 maintained at a regular voltage of 0.72v.

3 In the first embodiment, auxiliary amplifying circuit m is
4 newly inserted between low pass filter g and gamma correction
5 circuit h but may be inserted between gamma correction circuit h
6 and white clip circuit i, or between AGC amplifier e and low
7 pass filter g, or between signal input part 1 and AGC amplifier
8 e.

9 The above relationships are shown in the graphs of Figs. 2
10 (A), (B), (C). Fig. 2 (A) shows the relationship of object Lux
11 (abscissa) and video output voltage (ordinate) of the prior
12 device (dotted line) compared with this invention. The hatched
13 lines shows the broadened range for photographs in this
14 invention. Fig. 2 (B) shows the relationship of object Lux
15 (abscissa) and S/N ratio (ordinate) of this invention. Fig. 2
16 (C) shows the relationship of object Lux (abscissa) and gain of
17 auxiliary amplifying circuit m (ordinate) of this invention. In
18 the prior device, as shown in Fig. 2 (A), dotted line indicates
19 the prior device, photographing is impossible at object Lux of
20 0.02 Lux (S/N ratio is 40 dB).

21 In this invention, as shown in Fig. 2 (C), the object Lux
22 is lower than 0.02 Lux, the amplification degree increases, and
23 photographing is possible until an object of Lux 0.002 Lux. But
24 the S/N ratio is lowered to 25 dB as shown in Fig. 2 (B).
25 Second Embodiment.

1 Fig. 3 shows the second embodiment of this invention.

2 *ins A3* As shown in Fig. 2, in the second embodiment, in signal
3 processing circuit d of video camera using a CCD, area sensor
4 etc. an automatic gain control auxiliary amplifying circuit m_1
5 of high S/N ratio amplification degree 0 dB to 26 dB and an
6 automatic gain control auxiliary amplifying circuit m_2 of low
7 S/N ratio amplification degree 0 dB to 46 dB are provided.
8 According to necessity, it is possible to selectively using
9 automatic gain control auxiliary amplifying circuit m_1 of high
10 S/N ratio or automatic gain control auxiliary amplifying circuit
11 m_2 of low S/N ratio by switch S. V_{DD} is an electric source.

12 As shown in Fig. 2 (C), the object illumination is higher
13 than 0.02 Lux, amplification degree automatic gain control
14 auxiliary amplifying circuit m_1 of high S/N and low
15 amplification degree 0 dB to 26 dB works. For an object
16 illumination lower than 0.02 Lux, high amplification degree
17 automatic gain control auxiliary amplifying circuit m_2 works,
18 and the amplification degree increases. However the S/N ratio
19 is lower than 25 dB as shown in Fig. 2 (B).

20 **Third Embodiment.**

21 Fig. 4 shows the third embodiment of this invention.

22 As shown in Fig. 4, in the third embodiment, two automatic
23 gain control auxiliary amplifying circuits m_1 , m_2 are provided in
24 one AGC amplifying circuit em and their amplification degrees
25 are changed by switch S and voltage or current.

1 Maximum amplification degrees are 0 dB to 26 dB and 0 dB to
2 46 dB and their amplification degrees are selected by switch S.
3 Level of entering light are detected by level detecting circuit
4 r and controls the switch S and set the amplification degree to
5 a suitable value.

6 As explained in the construction, the same effects are
7 accomplished.

8 Effect of this invention.

9 According to this invention, in the case of sufficiently
10 bright object, photographing is performed by conventional
11 circuit, in the case of insufficient bright object, inserting
12 auxiliary amplifying circuit m , m_1 , m_2 or em , ignoring the S/N
13 ratio, and raising the amplification degree, in the case of a
14 sufficient bright object, photographing is performed by high S/N
15 ratio, and high degree, in the case of insufficient bright
16 object, inserting auxiliary amplifying circuit m , m_1 , m_2 or em ,
17 and ignoring S/N ratio, utility photographing is possible.